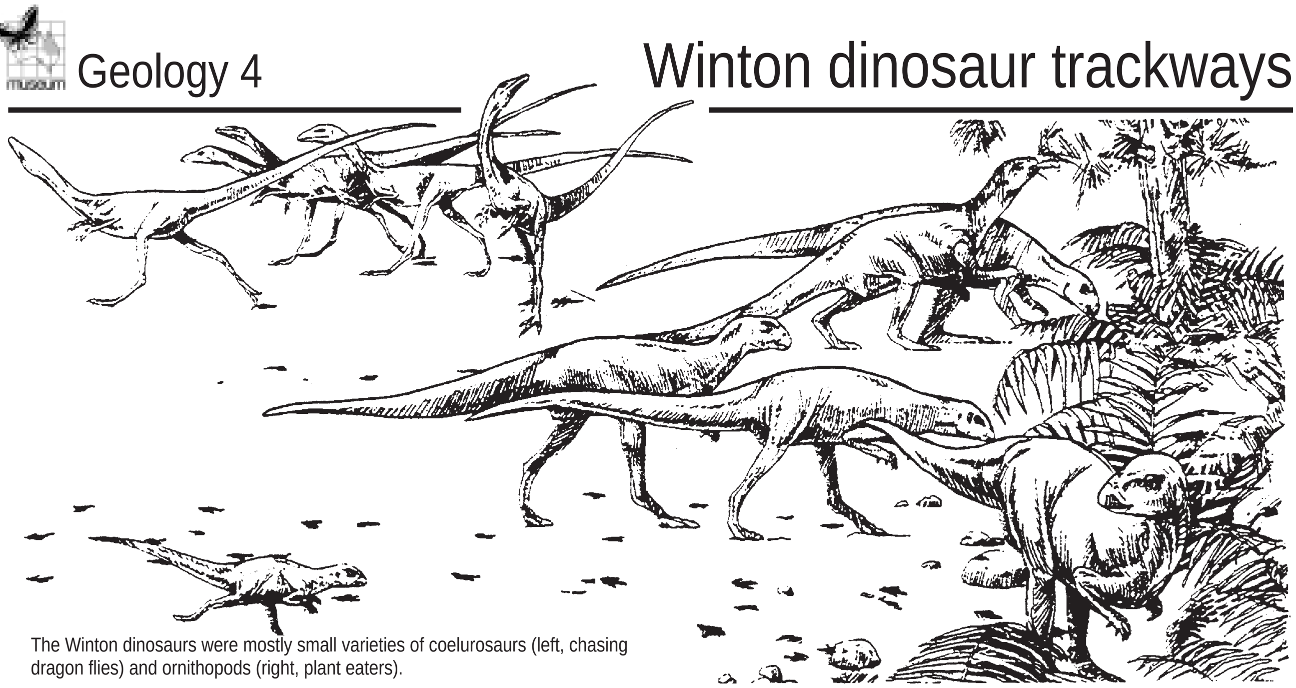
# Winton dinosaur trackways



The Winton dinosaurs were mostly small varieties of coelurosaurs (left, chasing dragon flies) and ornithopods (right, plant eaters).

## Winton dinosaur trackways

Lark Quarry Environmental Park, about 113 km south-west of Winton in Western Queensland, is the scene of one of the world's most remarkable scientific detective stories.

Thousands of dinosaur footprints embedded in shale and sandstone form the site of the world's first known dinosaur stampede. From the evidence of the footprints, scientists have been able to piece together the dramatic tale of a hunter and the hunted.

## Lark Quarry now and then

Lark Quarry is the largest of three excavations in the Environmental Park that have revealed dinosaur tracks. It is situated on top of a small promontory, on the eroded edge of the Tully Range. The stark flat-topped hills have steep sloping sides studded with spinifex. Stunted eucalypts survive along the watercourses in the sandy areas between these hills. To the west lie extensive Mitchell grass plains, while to the east the level top of the Tully Range is covered with lancewood, spinifex and barren zones of ironstone pebbles.

About 93 million years ago, during mid-Cretaceous time, the Lark Quarry area and the surrounding countryside looked quite different. Rainfall was a metre or more per year. The flat landscape was well-watered and conifers and ferns grew in abundance. The first flowering plants had just appeared.

The site where the Lark Quarry footprints were found was once a stream-bed leading into a lake. Scientists believe that the water level in this creek dropped, exposing a patch of half-dried, still plastic, mud on one side - and it was this area that retained the impressions of the dinosaurs' footprints. The sides and upstream end of the original deposit have weathered away.

## Footprints from the past

The Lark Quarry trackway exposure is 22 m by 22 m and roughly triangular. A trackway is the term give to the successive steps of one animal. From the size of its footprints, and length of its strides, scientists can determine how big an animal was, how freely it moved, whether it balanced well, and sometimes how quickly it turned.

Beneath the tracks of the main stampede there are some older tracks. These were made by medium-sized dinosaurs swimming in the lake and kicking the bottom at irregular intervals. There is also a larger trackway of an ostrich-sized ornithopod. This trackway has been partially eroded, probably by running water as the steam-bed drained dry.

However, the trackways that tell the most interesting story are those of a big theropod dinosaur and a large number of small or smallish coelurosaurs and ornithopods. These tracks have been preserved because they were filled with sandy sediments, before the mud had dried enough to crack.

The big theropod left 11 tracks in the mud. It took steps up to 2 m long, leaving three-toed prints up to 58 cm long. The animal's weight caused it to sink through the mud to the sand below, while the mud below the feet was squeezed out. The mud formed a raised ridge around each print and this gives the impression that the theropod's foot was larger than it actually was.

The size of the footprints suggests the theropod measured about 2.6 m from the ground to hip joint and the distance between the prints indicates it was walking at about 8 to 9 km/h. It could probably walk much faster. The large theropod placed its feet almost in front of one another as it walked and it could turn as sharply as a man - it made a full right-angle turn in two steps, starting on the wrong foot. There are no running steps in its trackway.

The trackway indicates the animal came toward the lake from the north. After six steps it shortened its paces, showing that it slowed to about 6 km/h. Footprints one to six are about 60 cm long, but footprint seven is only 40 cm. It is shallower than the other prints and two round claw punctures can be seen in the shale. There is still shale under the footprint and the short track shows that the foot did not mark the stiff clay until the theropod's weight had shifted to the front toes as it pushed forward. The clay almost held up 2-3 tonnes of big theropod, but it gave way under the tiny feet of little dinosaurs! Thanks to the larger surface area of its feet, the weight of the theropod was less, per area of foot, than that of the smaller dinosaurs.

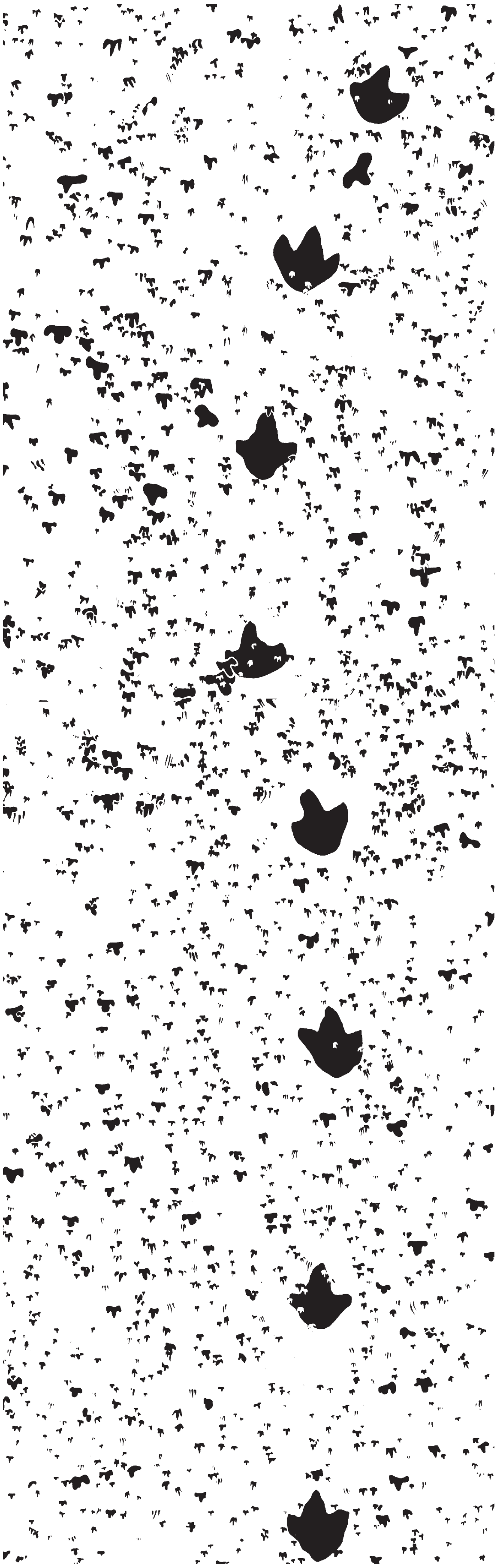
At the 10 th step, the large theropod had begun to turn right. It took one more step and then its tracks are lost. What happened after this is impossible to say because the side of the creek has been eroded away.

The theropod's tracks are crossed by a number of footprints made by a large group of small dinosaurs. Because these footprints imprinted the undried films of mud remaining in the big theropod tracks, scientists believe the smaller dinosaurs ran as one group across the mud while the theropod prints were still fresh.

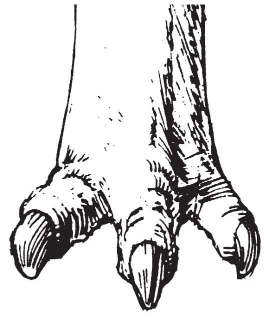
There were two types of small dinosaurs: probable coelurosaurs - the 'hollow (boned) lizards' and ornithopods, meaning 'bird-footed'. The coelurosaurs were about 13-22 cm at the hip and they left fowl-sized tracks. They were small predators and it is likely they ate eggs, insects and even some plants when hungry enough.

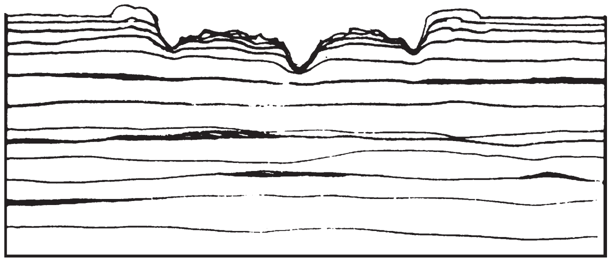
The ornithopods in the stampede were from bantam to emu-sized, about 12-65 cm at the hip. They were herbivores. The ostrich-sized trotting dinosaur mentioned earlier was a similar ornithopod with a

Nine big theropod footprints show the dinosaur walking, hesitating, going on and turning to its right. Fifty or more small dinosaurs bolting in the opposite direction were part of the world's only known dinosaur stampede. Some can clearly be seen overlaying the theropod prints



The depth of the footprint depends on weight per cm2 and the strength of the clay. All the dinosaurs in the trackways had three toes.

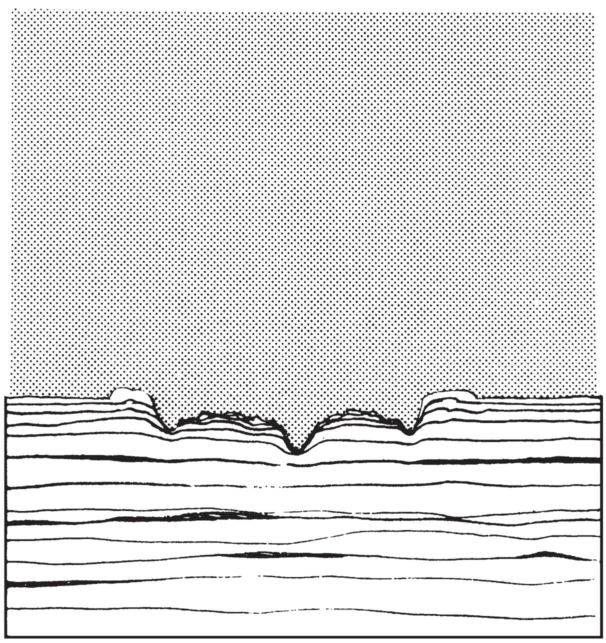




hip height of 1.5 m. All these dinosaurs stood, walked and ran on their toes, much like birds do. This type of movement is called digitigrade.

It is evident that the small dinosaurs were running, because the length between successive steps is greater than leg length. These coelurosaurs moved at about 9 to 15 km/h and ornithopods at about 10 to 30 km/h. The small dinosaurs crossed the quarry area in a fairly uniform spread so it is probable they were running from the big theropod.

Scientists have calculated that between 170 and 200 small dinosaurs ran through the area, but the total number is uncertain because both sides of the track-way have eroded away. The dinosaurs ran in one direction, away from the water's edge, with the bigger and smaller ornithopods and coelurosaurs travelling together. The dinosaurs were still running straight ahead in the Seymour Quarry area, the first site discovered, 95 m to the north-east.



Sand filled the imprint in the mud and built up above it. Both sediments hardened into rocks (sandstone and shale).

## What the trackway reveals

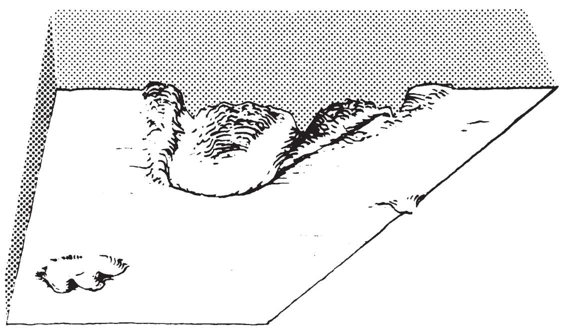
The single direction followed by the small dinosaurs indicates they were stampeding - probably fleeing the theropod, which may have trapped them at the edge of the water. The larger animals could run fastest, yet their prints are among the last left behind, suggesting the smallest animals left first. The reason why is not known.

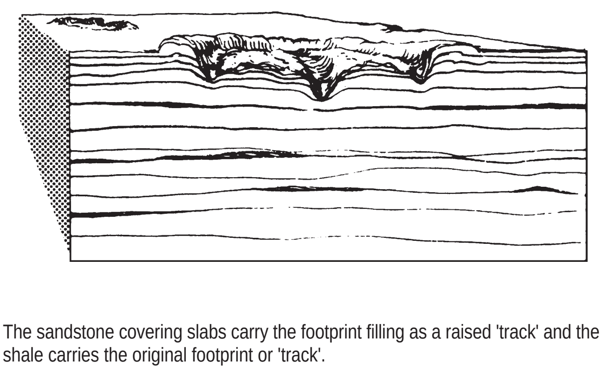
There are no footprints to show us how the small dinosaurs approached the lake, but studies of sediment layers show that a sandspit or bar once extended south-west into the area of the lake. Scientists believe the coelurosaurs and ornithopods may have approached the lake by the side of the stream-bed and moved down the sandspit to drink at the water's edge. There may have been several herds of ornithopods. Abundant evidence from elsewhere suggests that herbivorous dinosaurs often moved in groups. Herds of coelurosaurs were probably less common because hunting is a competitive life, but these little predators were no danger to other dinosaurs.

The big theropod may have been seeking a drink at the lake when it first scented or saw the potential prey animals. Most of the other dinosaurs were so small they were unlikely to attract or greatly fear a large theropod, but the larger ornithopods had sheep-sized bodies plus fleshy tails, and it was probably the sight of these that attracted the theropod down the sandspit.

The small dinosaurs - seeing, hearing or smelling the theropod - may have retreated down the spit of the creek. But the big theropod took a turn to the left - which is when its tracks are first seen - checked the breakout and approached the sandspit during the consequent retreat. The sharp turn right probably indicates another attempted breakout and another check.

We do not know the whole story of what occurred at Lark Quarry because not all the trackways have survived, but it is likely that the theropod may have trapped its prey in the attempt to cross the muddy shallows.





The sandstone covering slabs carry the footprint filling as a raised 'track' and the shale carries the original footprint or 'track'.

## Preserved through time

Although other dinosaur trackways are known in different parts of the world, the Lark Quarry site is among those with the largest number of trackways of animals - all doing the same thing. Some other larger masses of tracks are haphazardly distributed or were made at different times and by single animals or small groups moving in different directions. Tracks fround eleswhere indicate sauropod dinosaurs often moved in herds of 20-30. None show a stampede such as this.

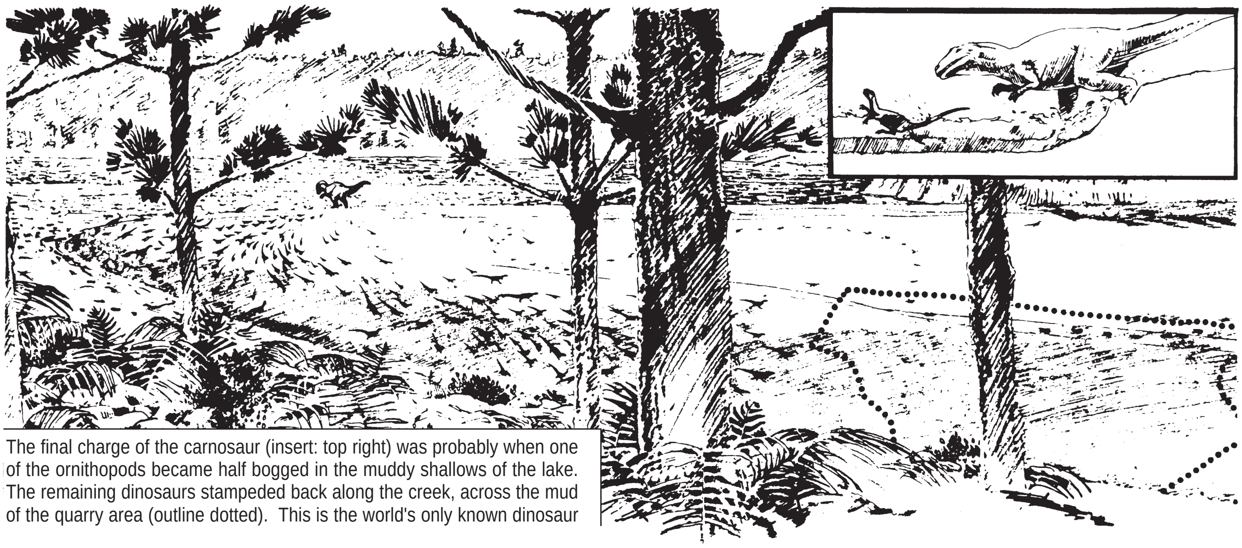
Sun, wind, rain and running water destroy most tracks. The existing tracks were probably fossilised because the lake rose gently and covered them with water before the next flood. This buried them below a metre of sand and a metre of mud, which is now 30 cm of shale. As time went by more sand and mud were added, and over millions of years the layers were compressed to form rock. The world changed, dinosaurs became extinct, landscapes altered.

The Queensland Museum displays a large fibre-glass cast of about one quarter of the trackway in the entrance foyer of the Southbank Campus. Here visitors can see the last nine theropod footprints and the many small imprints of the stampeding dinosaurs.

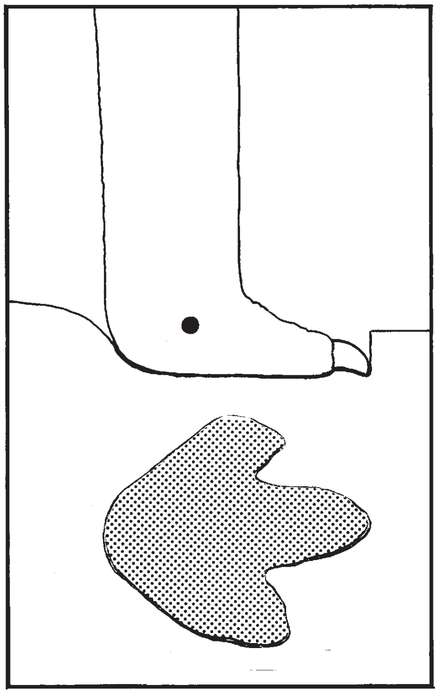
## Discovery and excavation

The trackway site was discovered in the early 1960s by Glen Seymour, the manager of a nearby grazing property. His find, Seymour Quarry, is named in his honour. The first Winton dinosaur footprints in the Queensland Museum were excavated from there in 1971. The Lark Quarry site was excavated by Queensland Museum officers and volunteers in 1976-7 and is named after Malcolm Lark, first of the volunteers, who removed more rock than anyone else.

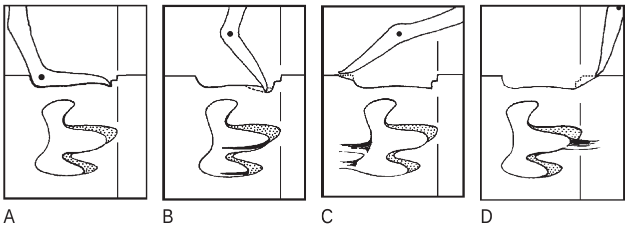
The worldwide importance of the site was recognised when it was proclaimed an environmental park. Today Lark Quarry Environmental Park covers 374 ha and is administered by the Queensland National Parks and Wildlife Service, under the trusteeship of Winton Shire Council and the Queensland Museum.



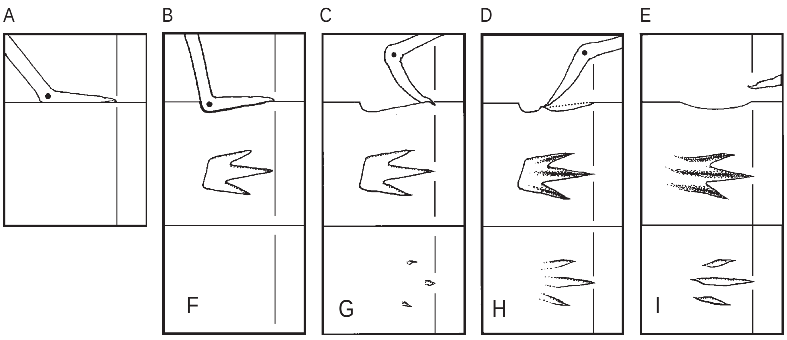
The final charge of the carnosaur (insert: top right) was probably when one of the ornithopods became half bogged in the muddy shallows of the lake. The remaining dinosaurs stampeded back along the creek, across the mud of the quarry area (outline dotted). This is the world's only known dinosaur



The theropod (2 or 3 kg/cm2) usually trod through the mud, and its weight was carried on the sand below.




The making of typical ornithopod tracks: (A) impact of foot into muddy surface. (B) Kick-off causing initial toe-drag inside footprint. (C) Kick-off with toe-drag behind footprint. (D) Kick-off with toe-drag in front of footprint.




The making of typical coelurosaurs tracks. (A) The initial impact of tiny light-weight coelurosaurs into the soft mud does not make much of a print. (B) The weight-bearing on the heel makes a deep print. (C) Transfer of weight to the toes creates a complete, three-toed print. (D) The sharp claws on each toe scrape the mud back toward the heel leaving three converging furrows. (E) The most common type of coelurosaur footprint. (F) In half-dried mud the coelurosaurs make no initial heel print. (G) In half-dried mud the toes leave prints due to their concentrated weight. (H) The weight-bearng toes scrape converging furrows. (I) Typical coelurosaur print in half-dried mud.

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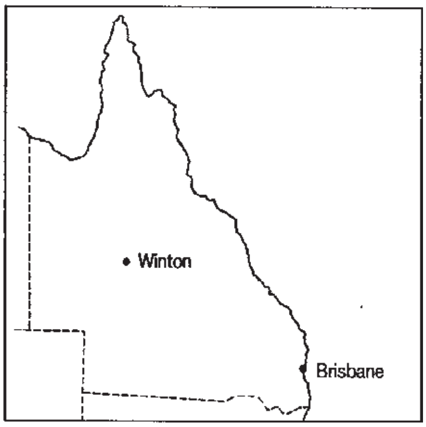


**Illustrations:** Robert Allen & Sally Elmer

**Further Information**

THULBORN, R.A. & WADE, M. 1984,
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